Comparison of Implementing Standard for RAMI with Top-Level Principles

The Regulatory Unit has previously reviewed the implementation of top level principles 4.2.7.1 and 4.2.7.2 for RAMI in DOE/RL-98-01 and DOE/RL-98-20. DOE/RL-98-20 identified three required actions (section 3.8) required prior to commencement of preliminary design. SRD revision 2, which has been reviewed and accepted by the RU, identified the implementing standards that satisfied the action items, thereby providing conformance with top level principles 4.2.7.1 and 4.2.7.2. Likewise, DOE/RL-98-01 identified actions to fully conform with top-level principle 4.2.2.4. This action was completed, as described in section 3.5 of DOE/RL-98-20, providing conformance with top-level principle 4.2.2.4. This change deletes two redundant citations of implementing standards in SC 4.2-3 and replaces the citation of ISMP section 3.13 with a new SRD appendix, which is essentially a verbatim reproduction of ISMP section 3.13. Hence, a review of the new appendix against the top-level principles is not necessary because the new appendix incorporates the requirements of the existing implementing standards, as discussed below.

Comparison of Implementing Standard for RAMI with ISMP Citations

ISMP Section and Text	How Met in New Appendix
1.3.10 Classification of Structures, Systems, and Components - Not reproduced here. See the ISMP	Appendix A of Volume II of the SRD was revised in Revision 2d to include the requirements for classification of structures, systems, and components, which makes the citation of ISMP section 1.3.10 redundant to the citation of Appendix A as implementing standards in safety criterion 4.2-3. Therefore, the requirements of ISMP section 1.3.10 are not included in the new appendix for RAMI.
3.7.1 Passive Features Facility processes are confined by at least two barriers: facility and process equipment provides the first barrier, and a cell or similar enclosure provides the second. This secondary confinement barrier has appropriate levels of shielding to ensure that radiological exposure does not exceed standards. Confinement and shielding design are established, as are the codes and standards that are used. Aspects of confinement design ensure that failure of one barrier does not lead to failure of the other (i.e., confinement is diverse). For example, should a process vessel or pipework leak (loss of primary confinement), the liquor drains to the cell sump where it can be recovered. The cell is lined to prevent liquor leakage. The potential for failure of a process vessel or piping is reduced by the selection materials resistant to erosion and corrosion and the use of direct inspection or erosion/corrosion coupons as discussed in Section 3.13, "Reliability, Availability, Maintainability, and Inspectability (RAMI)."	The requirements contained in this ISMP section that the facility processes be confined by at least two barriers is redundant to section 5.0, Development of Control Strategies, of Appendix A to the SRD that requires two barriers. Further, SRD Appendix A, Implementing Standard for Safety Standards and Requirements Identification, is the implementing standard for identification of hazards, selection of control strategies, and identification of implementing standards for the project. Therefore, the requirements of this section of the ISMP re: selection of barriers, design features, etc. are redundant to SRD Appendix A which is already an implementing standard for this safety criteria. The portion of this ISMP section pertinent to RAMI is the last sentence. This sentence provides a pointer to ISMP section 3.13, which is being incorporated into a new appendix to the SRD. Therefore, the requirements for erosion / corrosion monitoring for vessels and piping are included by citing the new SRD appendix as an implementing standard for this safety criterion.

ISMP Section and Text	How Met in New Appendix
3.13 RELIABILITY, AVAILABILITY, MAINTAINABILITY, AND INSPECTABILITY (RAMI) To ensure that the facility meets operational requirements, it is necessary to address issues associated with reliability, availability, maintainability, and inspectability. Reliability is used as a measure of the ability of an item or system to complete a task, and it is normally expressed as a probability of failure. Reliability is designed in through the use of appropriate design techniques and control of the mode of operation and the environment. Design techniques to be used vary because they are dependent on the specific item or system and the task to be performed. Their purpose is to optimize reliability by the following: 1) Use of proven materials and components 2) Design simplicity 3) Testability 4) Control of manufacturing standards 5) Control of operational mode (e.g., prevention of misuse and overloads) 6) Control of environment (e.g., protection against corrosion and vibration). Consistent with the BNFL process for tailoring hazard controls using the potential radiological and chemical consequences of individual events, reliability is assigned to SSCs based upon the importance of the SSC to the prevention or mitigation of accidents. The significance of accident prevention and mitigation is determined by the severity of the accident to workers or the public. To implement this tailoring in a clear, consistent, and defensible manner, BNFL Inc. has developed an Implementing Standard for Safety Standards and Requirements Identification. This Implementing Standard includes a Severity Level ranking system which provides the hazard assessment and control teams with a defined way to categorize the potential severity of those events that can result in radiological or hazardous exposure to the workers or the public. The Implementing Standard provides the means by which the hazard assessment and control teams establish target reliabilities for SSCs. Availability is a measure of the degree to which an item or system is in an operable condition. It is expressed quantitatively as the ratio of the mean time between failures to the sum of the mean time between failures and the mean time to repair. System availability is calculated to determine the potential for downtime. In this way, systems are identified that contribute to decreased availability. Required availability is achieved by specifying additional systems or increasing reliability of existing systems.	This ISMP section is being reproduced essentially verbatim in the new appendix to the SRD. The exception is: • TWRS-P has been replaced with RPP-WTP

ISMP Section and Text	How Met in New Appendix
Maintainability is a measure of the ability to restore a failed item or system to an operable condition in a specified time. Maintainability is designed into the facility and processes through use of appropriate design techniques, (e.g., the use of specially designed, remotely removable, and replaceable pumps and valves in process systems, and the placement of active pumps or valves within shielded accessible areas equipped with appropriate decontamination facilities that allow hands-on maintenance activities) and logistic support (e.g., scheduling and procedures). Benefits of these design techniques are that they simplify maintenance operations in high radiation areas and remove high maintenance equipment from high radiation areas. Testability of Safety Design Class systems and components is facilitated by such features as redundancy that allow for a system or component to be removed from service for maintenance or testing without loss of safety protection. Inspectability is the measure of the ease with which items or systems can be inspected for preventative maintenance or assessment of condition. Inspectability is used to monitor facility items in order to maintain their reliability. Inspectability of facility items can be designed in by the use of shielded access areas (as above, to reduce radiation exposure) for active equipment or the provision of monitoring equipment (e.g., material coupons for determining vessel corrosion rates, and in-cell cameras). During the design phase, the TWRS-P Facility and processes are evaluated for reliability, availability, maintainability, and inspectability. BNFL uses a number of validated modeling techniques (computer codes, mathematical modeling, failure modes, and effects analysis) for determining reliability and availability of the facility and processes. These are used to identify those facility and process areas that are sensitive with respect to influencing overall facility and process performance. Optimum reliability is established by the use of appropriate standards and quality control. The determination of maintenance and inspection needs is based on facility and process reliability requirements. It is a mixture of process optimization, provision of appropriate design features to aid preventative and scheduled maintenance and inspection, and the development of maintenance and inspection programs (administrative and procedural controls) whose objectives among other things, are to facilitate these activities. Reliability targets are assigned to SSCs only when a quantitative value has been credited for the reliability of an SSC in safety analysis.	
A hypothetical example of the application of RAMI to the TWRS-P Facility is the cooling water supply system to the technetium/cesium product storage tank. Cooling water is supplied to the this vessel to keep the contents from boiling thereby preventing the release of radionuclides and steam to the ventilation system. Failure of the cooling water system supply	The hypothetical example has been deleted from the implementing standard. The example was meant to show the application of RAMI and does not impose any requirements.

ISMP Section and Text	How Met in New Appendix
could lead to a hazardous situation or, at the least, operability concerns. The system comprises a closed-cycle primary system suppling (sic) chilled water to cooling coils within the vessel. Chilled water is supplied via a secondary chilled water circuit and heat exchanger. It should be noted that physical considerations indicate that the tank contents may reach their boiling temperature, but the predicted time required is on the order of several days. A conservative estimate of the minimum time to boiling assumes there is no heat transfer from the tank (ISAR Section 4.7.2.4, "Technetium/Cesium Product Storage Tank"). This supply system is analyzed using a commercially available computer program. The system is first broken down into major components (e.g., pumps and valves); for each component reliability data are obtained and an acceptable repair time specified. The computer model calculates total availability of the system throughout the "operating life" of many years. The overall reliability of the system is then determined by application of fault tree analysis. Failure rates for postulated faults are determined and sensitive items of the system with respect to failures are identified. No maintainability of the in-cell components (primary circuit) is required, as the design takes this into account (e.g., all welded pipework and enhanced testing). Inspection of the primary circuit takes place either indirectly through the use of coupons within the circuit to assess corrosion rates of the pipework and cooling coils or directly through visual (closed circuit television) means.	